(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 202 468**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 86105111.8

(22) Date of filing: 14.04.86

(51) Int. Cl.⁴: G 06 K 11/06
G 06 F 3/033, G 01 S 5/16
G 01 S 3/78, G 01 B 11/00

(30) Priority: 10.05.85 US 732864

(43) Date of publication of application:
26.11.86 Bulletin 86/48

(84) Designated Contracting States:
DE FR GB IT SE

(71) Applicant: The Laitram Corporation
220 Laitram Lane
Harahan Louisiana 70123(US)

(72) Inventor: Lapeyre, James M.
13 Richmond Place
New Orleans Louisiana 70150(US)

(74) Representative: EGLI-EUROPEAN PATENT ATTORNEYS
Widenmayerstrasse 5
D-8000 München 22(DE)

(54) Electro-optical position determining system.

(57) A position determining system for providing electrical signals representative of the positions of a light source movable within a defined area. The system may be implemented for purposes of data entry or for purposes of object location or surveying. When embodied in a data entry tablet, the invention provides signals representative of the positions of a stylus movable within the area of the tablet and comprising first and second photodetectors spaced along a base line by a predetermined distance, and means associated with each photodetector and operative to provide a movable narrow field of view for each photodetector. Means are provided for monitoring the angular position of each of the fields of view with respect to the base line and for providing a signal indication of the respective angular positions. A stylus having a light emitter at the tip thereof is movable within the area of the tablet and provides light detectable by each of the photodetectors. Each of the photodetectors provides a respective signal when the field of view of the corresponding photodetector receives light from the emitter. Means are provided which are operative in response to the signal indication of the angular position of each of the movable means at which light from the emitter is respectively detected to provide a signal representing the position of the emitter within the area of the tablet.

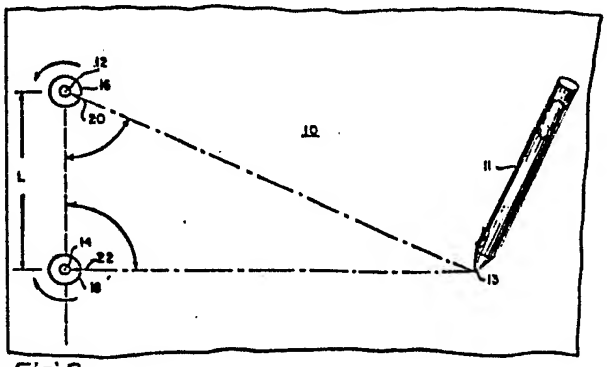

Fig. 2

EP 0 202 468 A1

FIELD OF THE INVENTION

This invention relates to position determining systems and more particularly to apparatus for providing electrical signals representative of the position of an object movable within a predetermined area.

BACKGROUND OF THE INVENTION

Systems are known for determining the position or location of an object within a defined area. Such systems find utility for the entry of graphic and other information into a computer, and are often embodied into a data entry tablet which includes means for sensing the position of a stylus or other point movable within a defined area, and for providing an electrical signal which is representative of successive stylus positions, thereby to denote lines, curves and figures drawn by the stylus on the tablet. Another known use for position determining systems is for land surveying and wherein means are provided for sensing the position of a target movable within a defined area, and for providing a signal representative of the sensed target positions and from which survey information can be derived.

A related data entry device is known as a cursor controller or "mouse", which is usually in the form of a small housing movable over a surface and which provides corresponding movement of a cursor on a display screen. Movement of the cursor can be employed for data entry of graphical information and can also be used as a pointer for identifying a position on the screen or information displayed on the screen, such as for interactive computer usage. In general, mouse

movement is provided by a ball that rolls over a surface, the ball movement being sensed by mechanical or optical means. Motion can also be sensed via a specially prepared sensible surface over which the mouse is moved. For example, a checkerboard pattern has been employed on a surface, and light reflected from the surface is detected by a photodetector which provides pulse signals indicative of motion with respect to the surface pattern. A review of several different types of mouse cursor controllers is provided in an article entitled "Interfacing Mice to Computers", Machine Design, January 12, 1984, pp. 84-91.

Graphic input devices are known using pairs of scanned light beams, as shown, for example, in U.S. Patents 3,553,680; 3,613,066; 3,364,389; and 4,294,543. In this type of entry device, first and second narrow light beams are scanned across a surface and means are provided for sensing the light beams at intersecting points within the surface, the angular position of the two beams at the detected intersections representing the position within the defined area. Another known technique employs orthogonal light beams provided across a display surface, the interruption of selected orthogonal pairs of beams providing an identification of the data entry point.

Examples of surveying and related systems for automatic position determination are shown in U.S. Patents 3,714,657; 3,400,398; 3,437,825; and 3,443,095. Range measuring systems are shown for example in U.S. Patents 2,830,487; 3,759,614; and 3,961,851.

SUMMARY OF THE INVENTION

The present invention provides a position determining system for providing electrical signals representative of the positions of a light source movable within a defined area. The system may be implemented for purposes of data entry or for purposes of object location or surveying. When embodied in a data entry tablet,

the invention provides signals representative of the positions of a stylus movable within the area of the tablet and comprising first and second photodetectors spaced along a base line by a predetermined distance, and means associated with each photodetector and operative to provide a movable narrow field of view for each photodetector. Means are provided for monitoring the angular position of each of the fields of view with respect to the base line and for providing a signal indication of the respective angular positions. A stylus having a light emitter at the tip thereof is movable within the area of the tablet and provides light detectable by each of the photodetectors. Each of the photodetectors provides a respective signal when the field of view of the corresponding photodetector receives light from the emitter. Means are provided which is operative in response to the signal indication of the angular position of each of the movable means at which light from the emitter is respectively detected to provide a signal representing the position of the emitter within the area of the tablet.

In one presently preferred embodiment, a rotating cylinder is provided for each photodetector, the cylinder having a slit providing a narrow field of view or line of sight which is rotatable at a constant and known angular velocity. The time of rotation of each of the cylinders is monitored with respect to a start or reference position such that the time elapsed between the start position and the time at which light from the emitter is detected by each of the photodetectors is known. The elapsed time is a measure of the angular position of the rotating cylinder with respect to the detected position of the emitter and from this angular information, the position of the emitter with respect to the detectors is readily determined by known geometrical relations. Alternatively, the angular position of each of the rotating cylinders can be determined by use of respective shaft angle encoders which provide signal indications of the rotational position of the respective cylinders and therefore the respective fields of view. In this latter instance,

angular position is measured directly, and the rotational velocity of the fields of view need not be constant or known.

The rotatable field of view can be provided by other means such as an opaque shield rotatably movable around each detector and operative to occlude light from the light source when in the line of sight between the source and the detector. A timing cycle can be commenced by the sensed change in received light upon passage of the leading or trailing edge of the shield. The moving field of view can also be provided by a linearly movable slit or other view limiting shield.

In another embodiment, a single photodetector is employed and is rotatable about an axis and operative to detect light from a source movable within a defined area at each of two predetermined positions in the path of rotation. The position of the light source in relation to the detector positions is then determined.

In an alternative embodiment, a pair of light emitters is provided along a straight edge which is movable within the tablet area and the position of each of the emitters is determined in the manner described above to provide an indication of the position of the straight edge within the tablet area. Additional commands can be provided in conjunction with the position data of the emitter or emitters to provide data corresponding with the position of the stylus or straight edge at intended portions of the tablet area.

DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a pictorial representation of a preferred embodiment of the invention;

Fig. 2 is a diagrammatic representation of a prefered embodiment of the invention;

Fig. 3 is a diagrammatic representation of one means for sensing cylinder rotation;

Fig. 4 is a diagrammatic representation of another means for sensing cylinder rotation;

Fig. 5 is a block diagram of the processing logic;

Fig. 6 is a diagrammatic representation of an alternative embodiment;

Fig. 7 is a diagrammatic representation of an alternative embodiment of the invention;

Fig. 8 is a pictorial representation of a detector and view limiting shield means employed in the embodiment of Fig. 7;

Fig. 9 is a diagrammatic representation of a further embodiment employing a view limiting shield which is linearly movable;

Fig. 10 is a diagrammatic representation of a rotatable mirror employed for directing received light to an associated detector;

Fig. 11 is a diagrammatic representation of an alternative rotating mirror arrangement for directing received light to an associated photodetector;

Fig. 12 is a diagrammatic representation of an embodiment of the invention employing fiber optic cables for directing light from two sensed positions to a single photodetector;

Fig. 13 and Fig. 14 are elevation and top views, respectively, of another embodiment utilizing a rotatable single detector and useful especially for land surveying purposes.

Fig. 15 is a diagrammatic representation of an embodiment of the invention employing three light receiving locations.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figs. 1 and 2, there is shown a data tablet having a defined area 10 within which a stylus 11 is movable. The stylus has a light emitter 13 such as a light emitter diode (LED) on the tip thereof. It should be understood, however, that the light provided by emitter 13 is not limited to light having a frequency in the visible range, and, in fact may preferably have a frequency in the infrared frequency range. First and second photodetectors 12 and 14 are provided along an edge of the tablet, the detectors being spaced apart by a predetermined distance L which defines a known base line. A pair of opaque cylinders 16 and 18 are provided around respective photodetectors 12 and 14, each of the cylinders having a respective slit 20 and 22, axially provided thereon to provide a narrow field of view or line of sight for light receivable by the respective photodetectors from the emitter 13. Each of the cylinders is rotatable by suitable motive means such as respective electric motors.

The angular position of each of the rotating cylinders is determined, in one embodiment, by measurement of the elapsed time of rotation of each of the cylinders with respect to a start or zero reference position. As illustrated in Fig. 3, a start position for each of the cylinders is defined by a fiducial mark 28 on the cylinder and which is sensed by sensor 29 to produce a signal which causes a clock counter in processing logic 30 (Fig. 5) to be started to provide a count representative of the angular position of the associated rotating cylinder with respect to the start position. The processing logic 30 also receives the outputs from photodetectors 12 and 14. The time elapsed between the start position and the time at which light from the

emitter is detected by each of the photodetectors is determined by logic 30 by use of known geometrical relationships. The elapsed time is a measure of the angular position of the rotating cylinders with respect to the detected position of the emitter and, from this angular information, the position of the emitter with respect to the detectors is readily determined. The logic 30 provides an output signal representative of the position of the emitter within the tablet area, and this signal can be provided to a display or other utilization apparatus.

An alternative embodiment is illustrated in Fig. 4 in which the angular position of each of the rotating cylinders is directly provided. Referring to Fig. 4, a shaft angle encoder is coupled to the cylinder 16, the encoder being operative to provide a signal representative of the rotational position of the associated cylinder. The encoder comprises an encoder disc 34 attached to and rotatable with the cylinder, and a light sensor 36 operative to receive light from source 38 which is directed through the disc 34. The sensor 36 provides signals which represent the rotation of the disc and cylinder 16. The encoder signals are employed by logic 30 in association with the photodetector signals to calculate the position of the emitter in relation to the detectors.

A further embodiment is illustrated in Fig. 6 in which a pair of light emitters 40 and 42 is provided in spaced relation along a straight edge which is movable within the tablet area. In the illustrated embodiment, the light emitters 40 and 42 are provided on a template 44 which is movable within the tablet area. The position of each of the emitters is determined in the manner described above to provide an

indication of the straight edge defined by the spaced emitters within the area of the tablet. The template can include a standard frame into which various template sheets are insertable, each providing symbols and forms as desired.

It may be desirable to distinguish between the respective emitters 40 and 42. This can be accomplished in several different ways, including the employment of different frequencies of light emission by the respective emitters, or by pulsing the emitters at different rates. If such coding of the light emissions is employed, the circuitry associated with the light sensors will include means for distinguishing between the respective light emissions.

In addition to the entry of the position of a stylus point or an edge and the display of such point or edge positions, additional information can be entered for display in association with the positional data or for other associated use. For example, characters such as numbers, letters and symbols 46 can be provided on the template 44 of Fig. 6 and such items can be displayed in association with the position and orientation of the defined edge by entry of such items. Such date entry can be, for example, by means of an optical pen 48 for selecting characters. Once the orientation of the defined edge or orientation of the template is known, in the manner described above, the position of each symbol, number or letter within the template is also known and can be readily entered into a data system for display such as by optical pen or other known means.

In the above embodiments, each detector has a rotating slit associated therewith for defining the respective narrow field of view. A further embodiment is shown in Fig. 7, which depicts a pair of

detectors 49 each having a transparent cylinder 50 disposed therearound with an opaque segment 52 on the cylinder. Each of the detectors can be similarly embodied as illustrated in Fig. 8. The detectors receive light from the light source 13 at all times except when temporarily occluded by the interposition of the opaque shield in the light path. The line of sight between the light source and detector can be specified at the leading edge or trailing edge of the moving shield. The arcuate length of the shield can be of any extent less than 360°. During the interval at which the shield occludes the light, the clock counters can be reset for the next timing cycle. In operation, a start signal can be provided as the leading edge of the shield enters the light path, causing a change in the sensed light, and a timing interval commenced for that rotational cycle of the cylinder. Alternatively, the passage of the trailing edge of the shield out of the light path can signify the commencement of a timing cycle.

The moving field of view can be otherwise coordinated with the detector and need not be by a rotating field of view, as described above. In the embodiment of Fig. 9, an opaque shield 54 is provided having a slit 56 therein. The shield being linearly movable in reciprocating fashion past the associated detector. Each detector includes a similar reciprocating shield. The line of sight between each detector and the light source is determined by the alignment of the respective slits with the respective light paths.

In the embodiment of Fig. 10, a rotating mirror 58 is employed to direct light from the light source 13 to the photodetector 49. Upon alignment of the reflecting surface 60 of the rotating mirror with the incident light, light is directed to the detector to specify the line of

sight for the position determining computation. Another mirror implementation is shown in Fig. 11, in which the mirror 62 is rotatable about the axis, and upon alignment of the reflecting surface 64 which the incident light, light is reflected to the detector 49, which in this implementation is top mounted such as on a support arm 66.

A further embodiment is illustrated in Fig. 12 in which a single photodetector 49a is employed. A pair of fiber optic cables 68 are provided, each coupling light from a respective sensing position to the single detector. The outer end 70 of each fiber optic cable 68 is disposed to receive light from the light source 13 as selectively provided by the moving field of view, such as a rotating cylinder 72 having a slit thereon, as in the embodiment of Fig. 3 described above. Other means can be provided for transmitting or reflecting light received from the respective light sensing positions to the single photodetector, such as a mirror or mirror assembly. The inner end 74 of each fiber optic cable is in light coupling relation to detector 49a.

It will be appreciated that the embodiments discussed above may be designed for use in land surveying but are more suitable for use with data entry tablets. However, the embodiment of the invention shown in Figs. 13 and 14 is especially suited for land surveying. A single photodetector 49b is mounted on the end of a boom 80 having a counterweight 82 at the other end thereof, the boom being mounted for rotation on a tripod 84 or other suitable support, and rotated at a known velocity by means of a motor 86. A light source 13a is provided at the point remote from the detector, the light from this source being detectable by the single detector at each of two positions, as illustrated in Fig. 14. In the illustrated embodiment, the positions

are shown at diametrically opposite positions of a rotary cycle. A narrow field of view for the detector is provided by any convenient means, such as a rotating slit as described above. Thus, a line of sight between the light source and each light sensing position of the detector is specified, and the position of the light source then determined. A smaller version of this single detector embodiment can also be employed for data tablet or other data entry purposes.

In all the embodiments discussed heretofore, it is assumed that there is a clear "line of sight" between the light source and the two light receiving locations. This would usually be the case with data entry tablets of the type described, where the selected area is always located on one side of the "base line" which extends between the two selected light receiving locations. However, in applications where the "selected area" to be monitored completely surrounds the base line extending between the two light receiving locations, or where there may not always be a clear "line of sight" between the light source and both of the light receiving locations (such as in land surveying where the line of sight might be blocked by a tree or other non-movable objects), complete surveillance of the selected area may not be possible.

Therefore, according to another embodiment such as diagrammatically illustrated in Fig. 15, a third light receiving location may be provided to assure complete surveillance of the area. In the illustration of Fig. 15, those elements which are the same as elements shown in the embodiment of Fig. 2, carry common reference numbers. As shown, a first base line L_1 is defined by light receiving diodes 12 and 14 which scan selected area 88 extending on both sides of base line L_1 as indicated by light pen 11A and 11B on the right side and light pen

110 on the left side. Normally almost all locations in the select area 88 would satisfactorily be scanned by light receiving diodes 12 and 14 such that the position of a light source could readily be determined. However in the event an object 88 which is opaque to light source 11B was located so as to block the line of sight between light pen 11B and light receiving diode 14 (which line of sight is represented by line segments 90 and 92). The light receiving diode 12 would not have an input to help determine the location of light pen 11B, and consequently the location of light pen 11B along the line of sight 94 could not be determined. However, according to the embodiment of the present invention show in in Fig. 15, there is also included a third light receiving diode 96 which is located at a known position and distance with respect to base line L_1. As is also clear from the illustration of Fig. 15, there are secondary base lines L_2 and L_3 established between the light receiving diodes 12 and 96, and 14 and 96 respectively. Consequently, the position of light pen 11B may readily be determined by processing the information from light receiving diode 12 and 96 with respect to base line L_2 in the same manner as the information from light receiving diode 12 and 14 was processed with respect to base line L_1. In a similar manner, if the line of sight between the light source and light receiving diode 12 is blocked, information from light receiving diode 14 and light receiving diode 96 may be used with respect to base line L_3 to determine the position of the light source. A third light receiving diode would also be necessary if the light source were to lie along an extension of a base line extending between two light receiving diodes even if there was no blockage of light paths. For example as shown in Fig. 15 light pen 11A lies along an extension of L_3 and consequently, it is impossible to determine the distance of the

light source from either light receiving diode 14 or light receiving diode 96. However, in this example the location of light pen 11A may readily be determined by processing the information received from light receiving diode 12 and light receiving diode 96 with respect to base line L_2.

Light pen source 11C is included to illustrate that the surveillance area or selected area completely surround the light receiving locations. Furthermore, although the light receiving diode 12, 14 and 96 are arranged in Fig. 15 so as to form an equilateral triangle to simplify the processing of data or calculations, the three locations of the light receiving diodes could form a right triangle or any other irregular triangle so long as the location and distance of each light receiving diode is known with respect to every other light receiving diode.

This invention is not to be limited by what has been particularly shown and described except as indicated in the appended claims.

CLAIMS

What is claimed is:

1. Apparatus for determining the position of a light source located with a selected area comprising:

light detecting means for monitoring the presence of light at first and second locations, said first and second locations spaced a first predetermined distance apart along a base line;

said light detecting means suitable for detecting light received from a first light source located within said selected area;

means for ascertaining a first angle between said base line and a first line extending from said first light source toward said first location, and for ascertaining a second angle between said base line and a second line extending from said first light source toward said second location; and

means responsive to said means for ascertaining for determining and providing signals representative of the position of said first light source within said selected area.

2. The apparatus of claim 1 wherein said means for ascertaining a first and second angle comprises:

means associated with said light detecting means for providing at each of said first and second locations a moving field of view which includes a point of reference associated therewith;

means for ascertaining the position of the moving point of reference with respect to said first location when such a point of reference intersects said first line; and

means for ascertaining the position of the moving point of reference with respect to said second location when such a point of reference intersects said second line.

3. The apparatus of claims 1 and 2 and wherein:

said light detecting means is further suitable for detecting light received from a second light source which is spaced from said first light source a second predetermined distance, the pair of light sources indicative of a straight edge movable within said selected area; and wherein

said means for ascertaining further ascertaining a third angle between said base line and a third line extending from said second light source toward said first location, and a fourth angle between said base line and a fourth line extending from said second light source and said second location; and

said means responsive to said means for ascertaining further determining and providing signals representative of the position of said second light source within said selected area and the position of said straight edge indicated by said pair of light sources within said selected area.

4. The apparatus of claim 2 wherein said first and second moving field of view moves arcuately around said first and second locations.

5. The apparatus of claims 1, 2 or 4 wherein said light detecting means comprises a pair of photodetectors positioned one each at first and second locations.

6. The apparatus of claims 1, 2 or 4 wherein said light detecting means for monitoring further comprises:

means for supporting said light detecting means at a known distance from a pivot point; and

means for pivoting said light detecting means around said pivot point such that said light detecting means intersects said first and second locations.

7. The apparatus of claim 2 wherein said light detecting means comprises a pair of photodetectors positioned one each at said first and second locations; and

said means for providing a moving field of view comprises a pair of opaque members located one each between said selected area and said pair of photodetectors, each of said opaque members defining a slit for transmitting a narrow beam of light from said source therethrough, and means for repetitively moving said opaque member and said slit defined therein along a known path to provide said moving field of view of said selected area.

8. The apparatus of claim 7 wherein said known path is a straight line adjacent first and second locations.

9. The apparatus of claim 7 wherein said known path is a circular path around said first and second locations.

10. Apparatus for providing signals respresentative of one or more positions of a light source movable within a selected area, comprising:

first and second photodetecting means spaced at first and second locations along a base line by a first predetermined distance;

means associated with each photodetecting means and operative to provide a moving field of view for each photodetecting means at said first and second

locations, said moving fields of view moving arcuately around said photodetecting means;

means for monitoring the angular position of each of the rotating fields of view with respect to the base line and providing signal indications thereof;

a first light source movable within the selected area and emitting light detectable by each of the photodetecting means;

the first photodetecting means providing a first signal upon receipt of light from said first light source within the field of view of the first photodetecting means;

the second photodetecting means providing a second signal upon receipt of light from said first light source within the field of view of the second photodetecting means; and

means operative in response to those signal indications of the angular position monitoring means at which light from the first light source is respectively detected by said first and second photodetecting means to provide a signal representing the position of the first light source within the selected area.

11. The apparatus of claim 10 and further including:

a second light source spaced along a predetermined line from the first light source for emitting light detectable by each of said photodetecting means, the first and second light sources defining a straight edge movable within the selected area;

the first and second photodetecting means being further operative to provide signals representative of light from said second light source being received within said first and second fields of view; and

said means to provide a signal representing the position of said first light source being further operative in response to those signal indications of said angular position monitoring means at which light from said second light source is

respectively detected by said first and second photodetecting means to provide signals representing said second light source and the position of said straight edge within said selected area.

12. The apparatus of claims 4 or 10 wherein said arcuately moving fields of view are rotating fields of view.

13. The apparatus of claim 12 wherein said means for providing a rotating field of view is operative to provide said rotating field of view at a predetermined angular velocity.

14. The apparatus of claim 13 wherein the predetermined angular velocity is constant.

15. The apparatus of claims 1, 2, or 10 wherein said light source is a light emitting diode.

16. The apparatus of claims 2 or 10 wherein said means for providing a moving field of view includes an opaque member moving between said selected area and each of said first and second locations, said opaque member having a slit therein to provide a narrow field of view.

17. The apparatus of claim 10 wherein each of said fields of view associated with said first and second locations include a first and second reference point respectively.

18. The apparatus of claims 4 or 17 wherein said means for providing a rotating field of view associated with each of said first and second locations includes at least a portion of an opaque cylinder with an axial slit therein which at least partially surrounds said first and second locations, and wherein said axial slit represents said first and second reference points.

19. The apparatus of claims 4 or 17 wherein said rotating fields of view are provided by an opaque shield means having a distinct boundary at least partially surrounding said first and second locations and said shield means operative to move around said first and second locations to interrupt light traveling from said light source toward said first and second locations, and wherein said distinct boundary on said opaque shield defines said first and second reference points.

20. The apparatus of claims 3 or 11 wherein each of said light sources are respectively coded, and wherein the photodetecting means is operative to distinguish between the respective light sources.

21. The apparatus of claims 3 or 11 and further including:

a template including said straight edge and having a plurality of information characters and symbols thereon;

means for selecting one of said plurality; and

means for providing a signal representative of said selected one of said plurality.

22. The apparatus of claims 1, 2, or 10 wherein said selected area is a data entry tablet and said light source is a stylus having a light emitter on the tip thereon, and movable on the surface of the data entry tablet.

23. The apparatus of claims 1, 2, or 10 wherein:

said light detecting means further monitor the presence of light at a third location spaced a second predetermined distance along a second base line from said first location; and

said means for ascertaining further ascertaining a third angle between said second base line and said first line, and a fourth angle between said second base line and a third line extending from said first light source toward said third location.

24. A data entry system for providing signals representative of one or more positions of a stylus movable within a defined area, comprising:

first and second photodetecting means spaced along a base line by a predetermined distance;

means associated with each photodetector and operative to prove a rotating narrow field of view for each photodetector;

means for monitoring the angular position of each of the fields of view with respect to the base line and providing signal indications thereof;

a stylus having a light emitter movable within the area of the tablet and providing light detectable by each of the photodetecting means;

the first photodetector providing a first signal upon receipt of light from the emitter within the field of view of the first photodetector;

the second photodetector providing a second signal upon receipt of light from the emitter within the field of view of the second photodetector; and

means operative in response to the signal indications of the angular position monitoring means at which light from the emitter is respectively detected by said first and second photodetecting means to provide a signal representing the position of the emitter within the defined area.

25. The apparatus of claims 1, 2, or 10 wherein said selected area is a land area to be surveyed, and said light source is a reference pole which selectively emits light of predetermined characteristics and is movable over said land area.

26. A method for determining the position of a light source located within a selected area comprising the steps of:

emitting light having selected characteristics from a light source located within a selected area;

scanning said selected area from first and second locations spaced a predetermined distance apart along a base line and monitoring the presence of said emitted light at each of said two separate locations;

determining a first angle between said base line and a first line of sight extending between said light source and said first location, and a second angle between said base line and a second line of sight extending between said light source and said second location; and

computing the location of said light source within said selected area from said first and second angles and said predetermined distance.

27. A data entry tablet for providing signals representative of one or more positions of a stylus movable within the area of the tablet, comprising:

first and second photodetectors spaced along a base line by a predetermined distance;

means associated with each photodetector and operative to provide a rotating narrow field of view for each photodetector;

means for monitoring the angular position of each of the fields of view with respect to the base line and providing signal indications thereof;

a stylus having a light emitter movable within the area of the tablet and providing light detectable by each of the photodetectors;

the first photodetector providing a first signal upon receipt of light from the emitter within the field of view of the first photodetector;

the second photodetector providing a second signal upon receipt of light from the emitter within the field of view of the second photodetector; and

means operative in response to the signal indications of the angular position monitoring means at which light from the emitter is respectively detected by said first and second photodetectors to provide a signal representing the position of the emitter within the area of the tablet.

28. The data entry tablet of claim 27 further including:

a second light emitter spaced along a predetermined line from the light emitter of the stylus, the pair of light emitters defining a straight edge movable within the area of the tablet;

the first and second photodetectors being operative to sense light from each of the emitters and provide signals representative thereof; and

said means to provide a signal representing the position of the emitter being operative in response to the signal indications of the angular position of each of the rotating means at which light from the emitters is detected to provide a signal representing the position of the emitters and the straight edge within the area of the tablet.

29. The data entry tablet of claim 27 wherein the means associated with each photodetector is operative to provide a rotating field of view at a predetermined angular velocity.

30. The data entry tablet of claim 29 wherein the predetermined angular velocity is constant.

31. The data entry system tablet of claim 27 wherein the stylus includes the light emitter on the tip of the stylus movable on the surface area of the tablet.

32. The data entry tablet of claim 31 wherein the light emitter is a light emitting diode.

33. The data entry tablet of claim 27 wherein said means operative to provide a narrow field of view includes for each photodetector:

an opaque housing having a slit therein to provide the narrow field of view for light receivable by the photodetector from the light emitter.

34. The data entry tablet of claim 33 wherein the housing is a cylinder having an axial slit thereon.

35. The data entry tablet of claim 28 wherein each of the light emitters are respectively coded, and wherein the photodetectors are operative to provide respective first and second signals for distinguishing between the respective light emissions.

36. The data entry tablet of claim 28 further including:

a template including said straight edge and having information characters thereon; and

means for reading the information characters.

37. A data entry system for providing signals representative of one or more positions of a stylus movable within a defined area, comprising:

first and second photodetectors spaced along a base line by a predetermined distance;

means associated with each photodetector and operative to provide a rotating narrow field of view for each photodetector;

means for monitoring the angular position of each of the fields of view with respect to the base line and providing signal indications thereof;

a stylus having a light emitter movable within the area of the tablet and providing light detectable by each of the photodetectors;

the first photodetector providing a first signal upon receipt of light from the emitter within the field of view of the first photodetector;

the second photodetector providing a second signal upon receipt of light from the emitter within the field of view of the second photodetector; and

means operative in response to the signal indications of the angular position monitoring means at which light from the emitter is respectively detected by said first and second photodetectors to provide a signal representing the position of the emitter within the defined area.

0202468

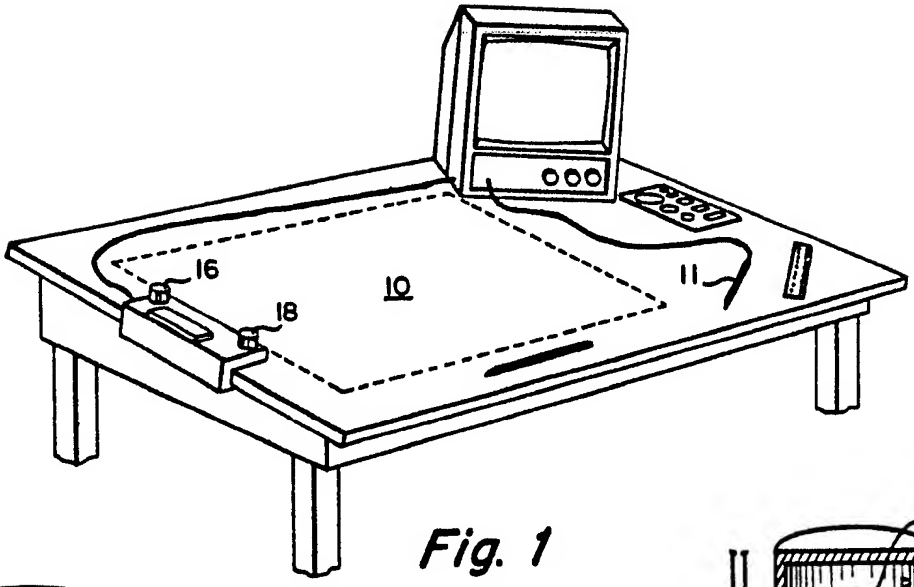

Fig. 1

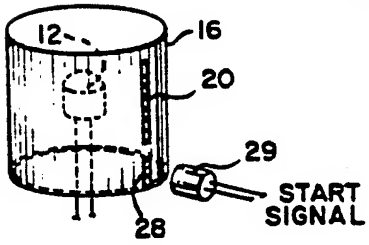

Fig. 3

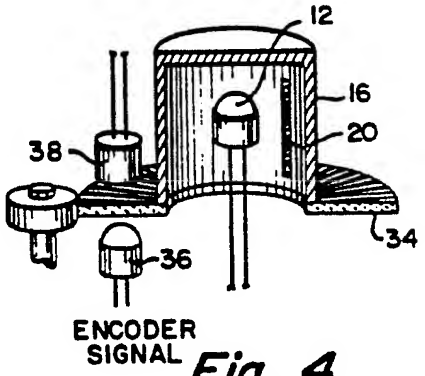

Fig. 4

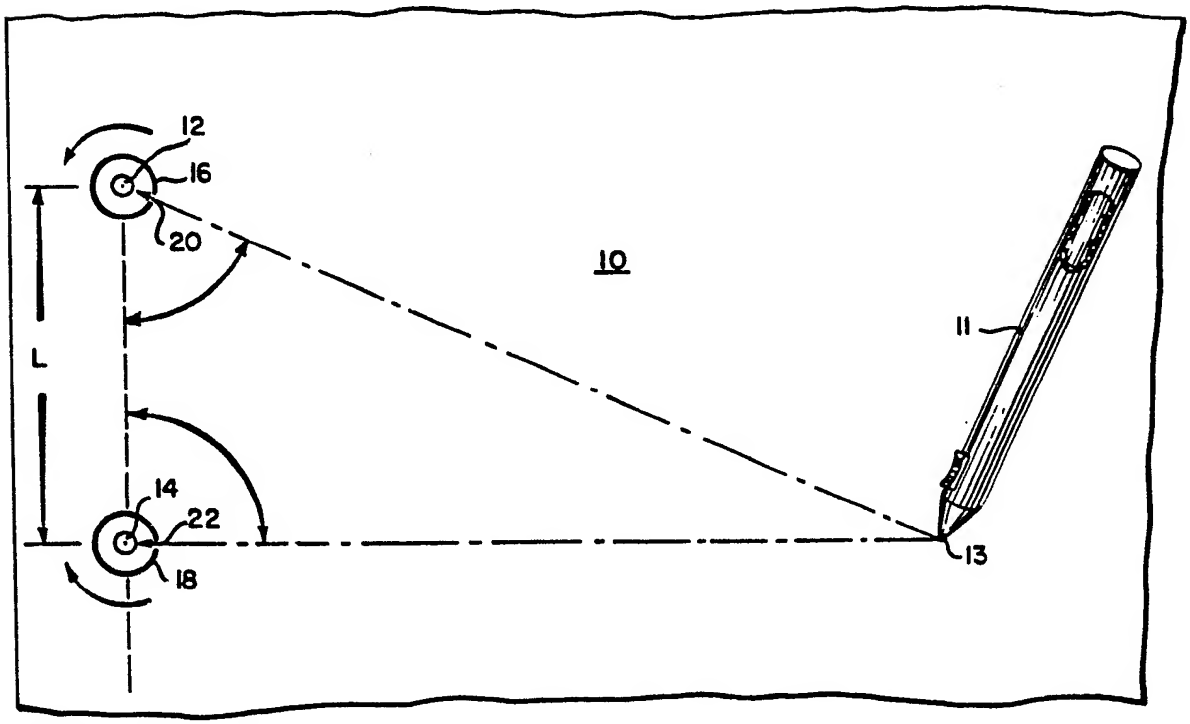

Fig. 2

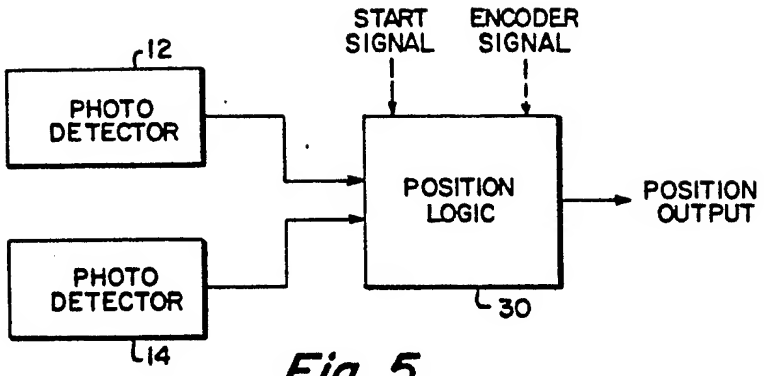
START SIGNAL
ENCODER SIGNAL
12
PHOTO DETECTOR
POSITION LOGIC
POSITION OUTPUT
PHOTO DETECTOR
30
14

Fig. 5

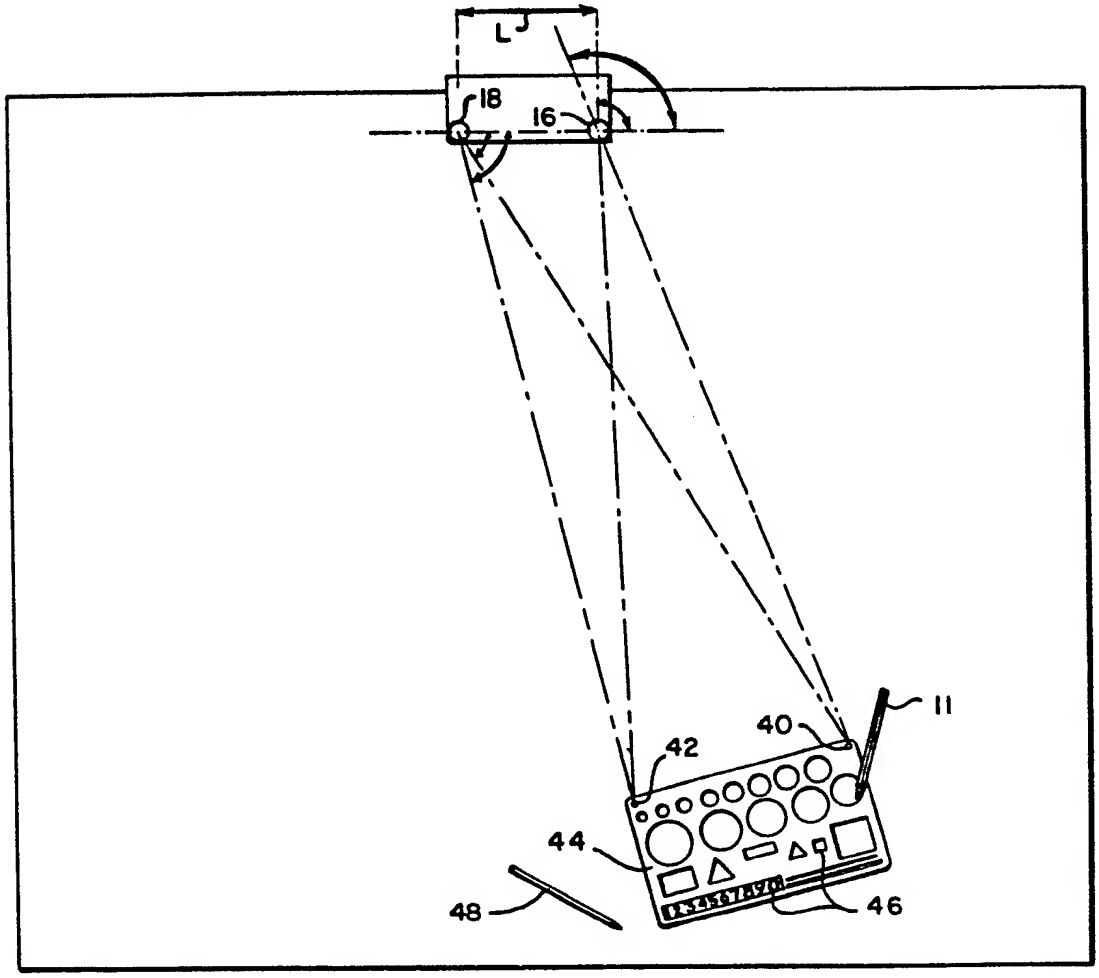
L
18
16
11
40
42
44
48
46

Fig. 6

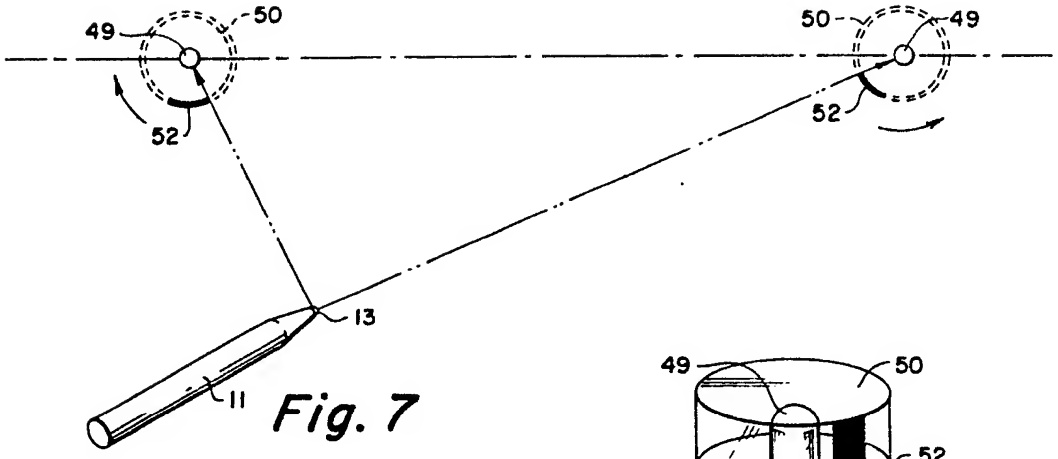

Fig. 7

Fig. 8

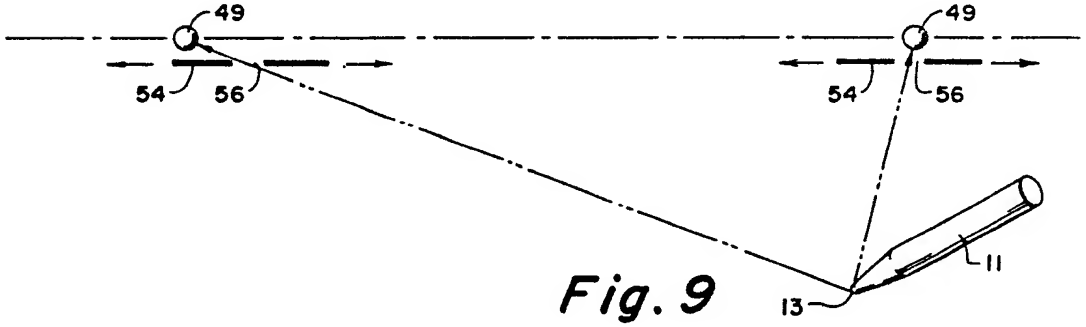

Fig. 9

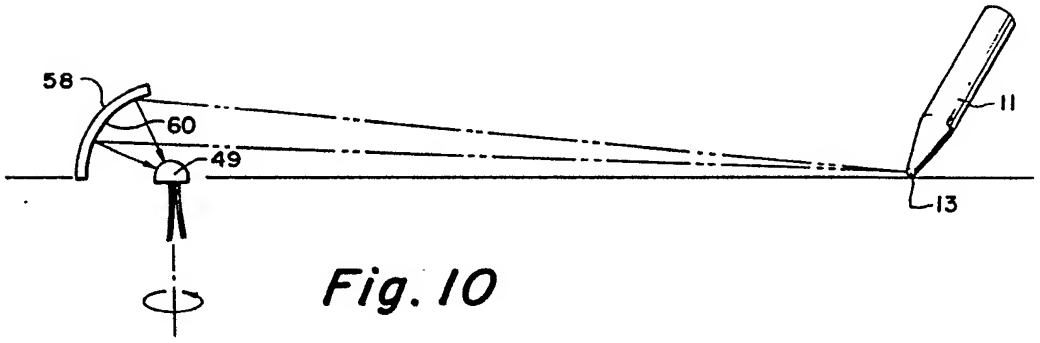

Fig. 10

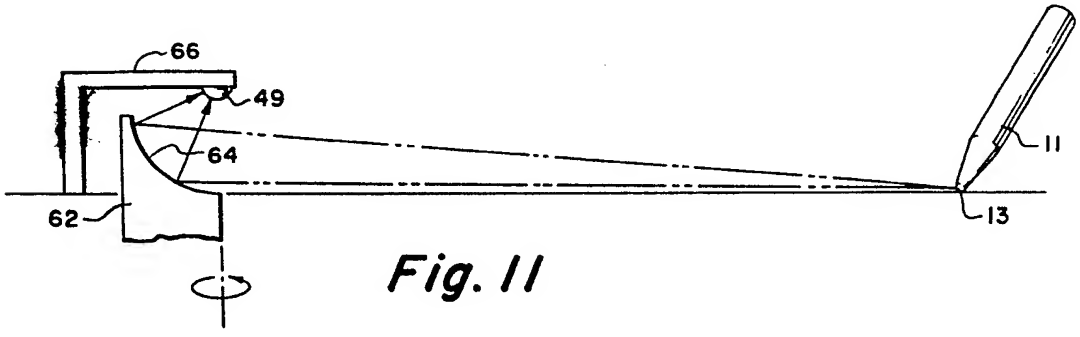

Fig. 11

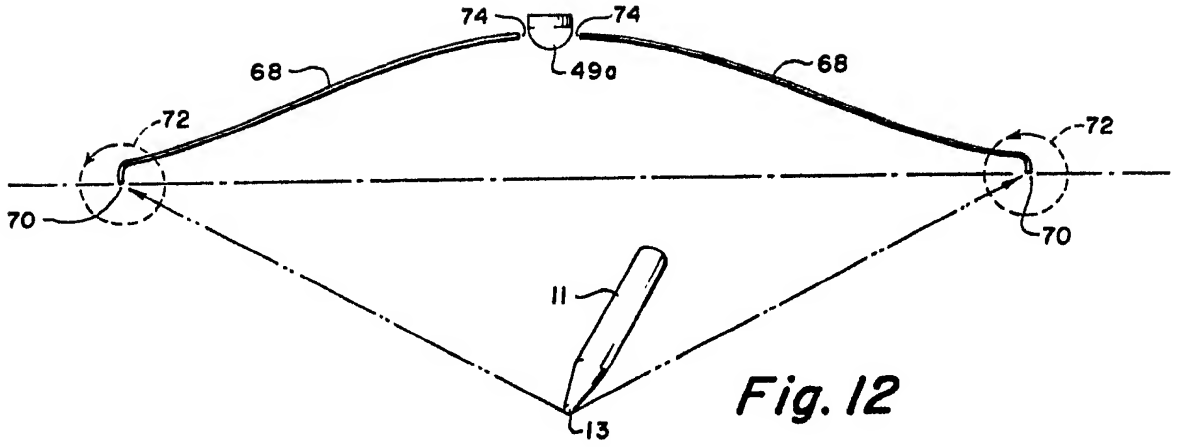

Fig. 12

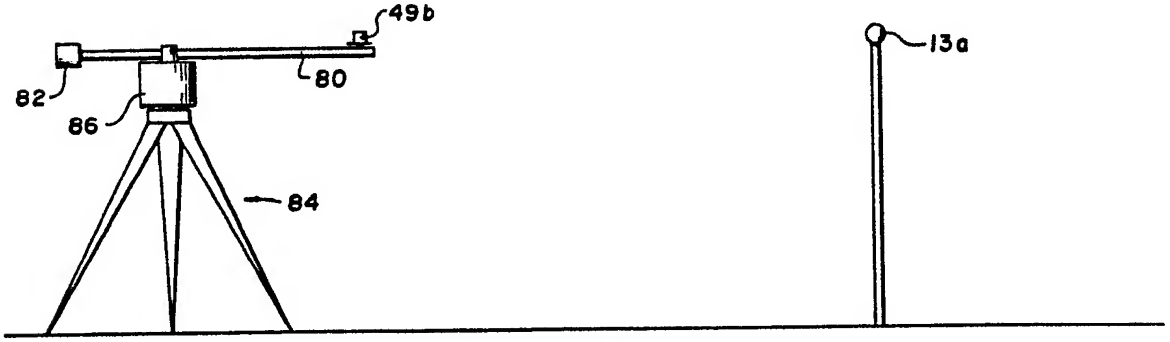

Fig. 13

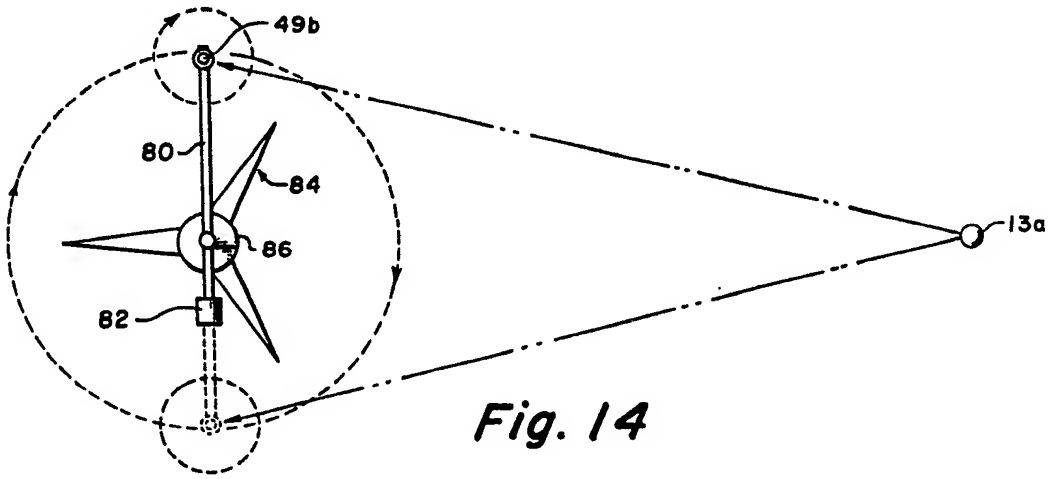

Fig. 14

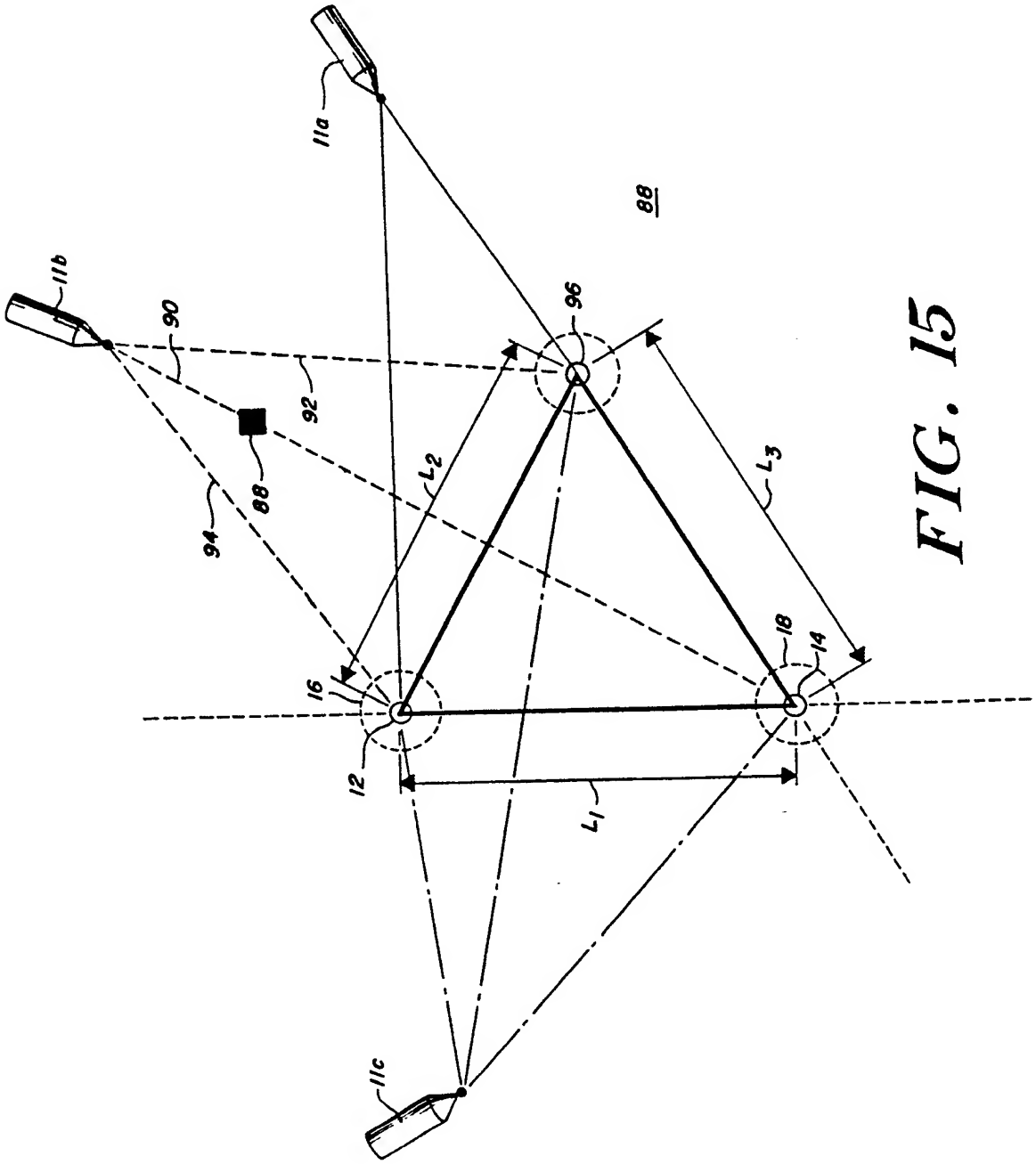

FIG. 15

0202468

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 86 10 5111

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
X	PATENTS ABSTRACTS OF JAPAN, vol. 7, no. 152 (P-208)[1297], 5th July 1983; & JP - A - 58 64 581 (SHIN NIPPON DENKI K.K.) 16-04-1983 * Whole document *	1,2,4, 5,10, 12,13, 22,24, 27,29-32,37	G 06 K 11/06 G 06 F 3/033 G 01 S 5/16 G 01 S 3/78 G 01 B 11/00
Y	idem	3,6,11 ,23,25 ,28	
X	US-A-3 613 066 (C.R. GOOREMAN) * Column 1, line 74 - column 3, line 62; figures *	1	
A		10,24, 26,27, 37	TECHNICAL FIELDS SEARCHED (Int Cl 4) G 06 K 11/06 G 06 F 3/033 G 06 F 3/037 G 01 S 5/16 G 01 S 3/78 G 01 B 11/00 G 01 S 17/46
X	DE-A-2 208 559 (E. SICK) * Page 2, lines 7-26; page 6, line 11- page 7, line 6; figure 1 *	1	
A		10,24, 26,27, 37	

-/-

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22-08-1986	CERVANTES J.P.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03 82

European Patent Office

EUROPEAN SEARCH REPORT

EP 86 10 5111

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
Y	US-A-2 830 487 (L.E. GRIFFTITH) * Column 1, lines 50-61; column 2, lines 10-15,28-36; figures 1,2 *	6	
A		13,14, 25,30	
Y	US-A-4 209 254 (REYMOND et al.) * Abstract; figure 3 *	3,11, 28	
A		23	
P,X	US-A-4 550 250 (MUELLER et al.) * Abstract; figure 1 *	1	
X	US-A-4 470 122 (SARR) * Abstract, figures 2,4,5 *	1	TECHNICAL FIELDS SEARCHED (Int Cl 4)
A		2,4,10	
A	US-A-4 012 588 (DAVIS et al.)		
A	FR-A-2 093 168 (COMMISSARIAT A L'ENERGIE ATOMIQUE)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22-08-1986	CERVANTES J.P.J.

CATEGORY OF CITED DOCUMENTS

X particularly relevant if taken alone
Y particularly relevant if combined with another document of the same category
A technological background
O non-written disclosure
P intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03 82